

REMARKS/ARGUMENTS

Claims 1-17 are currently pending in this application. In this amendment, claims 18-34 are cancelled without prejudice or disclaimer. Claims 33-36 have been added for the Examiner's consideration. Applicants submit that no new matter has been added. Support for newly added claims 33-36 may be found at least in Figures 12-15.

The Office Action rejects all pending claims under 35 US C. § 101 "because the disclosed invention is wholly inoperative and therefore lacking credible utility." Office Action at ¶ 2. The Office Action rejects all pending claims under 35 U.S.C. § 112, first paragraph, "as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected to make and/or use the invention." Office Action at ¶ 3. Applicants respectfully traverse these rejections.

In order to expedite prosecution and place this case in clear condition for allowance, the Applicants concurrently file herewith Declarations Under Rule 132 of three experts, Neil Rondorf ("Rondorf Declaration"), Vickie Singleton ("Singleton Declaration"), and Isaac Ginis ("Ginis Declaration").

CLAIM REJECTIONS 35 U.S.C. § 101

The Office Action rejects all pending claims under 35 U.S.C. § 101 "because the disclosed invention is wholly inoperative and therefore lacking credible utility." Office Action at 2. The Applicants respectfully submit this rejection should be withdrawn for all of the reasons discussed in the response of September 15, 2004. However, this rejection is clearly untenable in light of the Rondorf Declaration, Singleton Declaration, and Ginis Declaration, concurrently filed herewith, that support Applicants' asserted specific and substantial utility.

First, as discussed in the response of September 15, 2004, Applicants maintain that the Examiner has failed to establish a *prima facie* showing of no specific and substantial credible utility. Claim 1 is directed to reducing the intensity of a hurricane by positioning submersibles in a certain area; maneuvering the submersibles to a predetermined depth;

maintaining the submersibles in the area and at the depth for a predetermined amount of time; and releasing gas to rise in a plume toward the surface, the plume entraining cool water, from the depths and bringing it to the surface to cool the ocean surface and thus reduce the intensity of a hurricane. Applicants reassert the following arguments for independent method claims 8 and 14, which, while being independent and distinct from independent claim 1 rely on similar logic and underlying facts.

Reduction of Sea Surface Temperature and Reduction of Hurricane Intensity:

Applicants have asserted facts in the disclosure of the application that show that reduction of sea surface temperatures can reduce the intensity of hurricanes. The disclosure contains sufficient evidence and reasoning to permit a person of ordinary skill in the art to believe the asserted utility. For example:

[0005] Because tropical storms draw their energy from the heat content of the upper ocean, it is generally accepted that a large area of cooled ocean surface can suppress hurricane intensity. Numerical modeling studies at the Massachusetts Institute of Technology suggests that reduction of sea surface temperature by 2.5°C in the storm's central core would eliminate the thermodynamic conditions that sustain hurricanes. Other numerical model studies by independent researchers corroborate these results. In addition, analyses of measurements from past hurricanes show a strong correlation between lack of hurricane intensification and conditions that favor cold-water upwelling by the storm's own winds, such as a shallow thermocline or slow forward speed. Finally, there is clear evidence that hurricanes weaken (or do not intensify under otherwise favorable conditions) when a hurricane crosses the cold "wake" of a previous storm.

* * *

[0007] The physics of natural and artificial hurricane intensity control appear to be governed by sea surface temperature (SST) and the thermal structure (density stratification) of the upper ocean. These influences are combined into a single parameter, Hurricane Heat Potential (HHP), which is used by meteorologists to quantify the heat energy in the upper ocean that is available to fuel a tropical storm. Since SSTs less than 26°C typically cannot support hurricane development, HHP is defined as the heat content in excess of 26°C typically per unit area of the underlying water column between the sea surface and the depth of the thermocline.

All such excess heat in this layer of water can be readily mixed from top to bottom by hurricane winds and is thus available to fuel the storm's atmospheric convection. A discussion of the scientific basis for hurricane intensity control, which includes discussions on: formation, development, and features of tropical storm systems; natural processes that limit hurricane intensity; and sea surface temperature and hurricane heat potential; and the definition of hurricane interception regions may be found in section 2.0 of Provisional Application Serial Number 60/253,111 filed November 28, 2000 titled "Method and Apparatus for-Reducing the Intensity of Hurricanes at Sea by Deep-Water Upwelling." [incorporated by reference in its entirety]

In addition to the disclosure described above, Applicants submit the Ginis Declaration, which provides support that reduction of sea surface temperatures can reduce the intensity of hurricanes. Dr. Ginis attests that he is a leading expert in numerical modeling and forecasting of sea-air interaction during hurricanes. (Ginis Declaration, ¶1). Furthermore, he has published over 70 papers in scientific journals and books on this topic. (¶1). Dr. Ginis attests that the effect of air-sea interaction as a negative feedback on tropical cyclone development and intensity is well established. (¶8).

Specifically, Dr. Ginis states that the effect of air-sea interaction as a negative feedback on tropical cyclone development and intensity has been well established. (¶8). It is known that strong surface winds in a tropical cyclone induce turbulent mixing in the upper ocean and entrainment of the underlying cold water into the ocean mixed layer, which cools and deepens. (¶8). Both observational and real case numerical studies showed that the SST anomalies induced by tropical cyclones can reach up to 5-6°C. (¶8). Studies also showed that tropical cyclone intensity is more sensitive to the local SST changes under the hurricane core than to those beyond the core area. (¶8). Therefore, it can be expected that cooling of the ocean area underneath the hurricane core may reduce its intensity. (¶8).

Furthermore, Dr. Ginis conducted two numerical modeling studies, the 2°C swath experiment and the 1°C swath experiment, that suggest that a reduction of sea surface temperature by 2.5°C in the storm's central core would eliminate the conditions that sustain hurricanes. (¶9). In the modeling studies, the hurricane intensity was reduced after the storm

encountered the cooled regions. (¶15). The maximum winds were reduced from about 145 kts to about 135 kts (6% reduction) in the 1°C swath experiment and to about 130 kts (10% reduction) in the 2°C swath experiment. (¶15).

Bubble-Plume Dynamics to Reduce Sea Surface Temperature

Next, the pending application describes how to calculate the total volume of upwelling water, required to weaken a major hurricane. *See* Appln at ¶¶ 0040-53. Note especially the equation given in paragraph 0052, which provides one of skill in the art with the fraction, f , of the total interception area volume that must be replaced by upwelling water in order to achieve a final layer temperature of 26°C in accordance with the example provided.

In addition to the description in the disclosure, Applicants submit the Singleton Declaration which provides support that one of ordinary skill in the art using the amount of direction provided for in the specification in combination with the knowledge of one skilled in the art is able to calculate the total volume of upwelling water and total volume of gas required that would create an upper ocean area of sufficiently lower temperature. Specifically, in her Declaration, Ms. Singleton attests that she holds a Master of Science in Civil Engineering, specializing in bubble plume dynamics and is currently a 4th year Ph.D. candidate studying bubble plume dynamics. (Singleton Declaration, ¶1). Ms. Singleton has provided as Exhibits A-F to her Declaration a copy of references directed to bubble plume dynamics and artificial upwelling to create cooler upper layer water areas of cooler temperature. (¶6).

In order to calculate an estimate of the gas flow rate required to induce an adequate upwelling flow rate, Ms. Singleton applied to existing bubble-plume models. The bubble-plume models are based upon the references attached as Exhibits A-F. (¶6). In order to apply the models, Ms. Singleton used profile data collected off the eastern coast of Florida on September 19, 2007 to determine boundary condition profiles of temperature and water salinity. (¶7). Using the boundary conditions, Ms. Singleton ran each model over a range of applied gas flow rates to a single diffuser system or unit to arrive at the plume water flow rates, which

represent the upwelling flow rate from deeper water into the effective epilimnion. (§8). Ms. Singleton further attests that it would be expected that the artificial upwelling of the deep, cold seawater to the sea surface later by the bubble-driven plume would create an upper ocean layer region of sufficiently lower temperature. (§8). Finally, Ms. Singleton has calculated the total volume of liquid CO₂ required for the upwelling using the model estimated water flow rate values for linear and circular diffusers to be $1 \times 10^8 \text{ m}^3$ and $1.3 \times 10^8 \text{ m}^3$ for linear and circular diffusers, respectively. (§9). While the total amount of CO₂ is different than the volume of gas disclosed in the application, it is within a range accounted for by the different assumptions by Ms. Singleton, i.e., depth of the thermocline and geography of the area. In any event, the volumes of CO₂ required are still within reason.

Submersibles to Achieve Upwelling

Additionally, the application presents three well-reasoned descriptions of how submersibles could achieve the upwelling required to reduce the intensity of the hurricane: 1) submersibles maneuvering while upwelling (*see* §§ 0054-57); 2) submersibles maneuvering before upwelling (*see* §§ 0058-60); and 3) submersibles targeting half of the storm central core (*see* §§ 0061-64). Each of the three succeeding methods are presented to illustrate the impact of the method on the total upwelling rate required to reduce the intensity of a hurricane. Values of the volume of water to be upwelled are calculated and presented for examination and comparison.

In addition to the disclosure, Applicants submit the Rondorf Declaration which provides support that the type and number of submersibles required for implementing the claimed invention may be readily ascertained by using the amount of directed provided for in the specification. In the Rondorf Declaration, Mr. Rondorf attests that he is the Assistant Vice President of Science Applications International Corporation headquartered in McLean, Virginia. (Rondorf Declaration, §1). Furthermore, Mr. Rondorf has over 25 years of management and technical engineering of Navy programs including shipboard operations and Integrated Undersea

Surveillance System programs. In particular, Mr. Rondorf attests that based on his experience and construction methods available on or before November 28, 2001, the filing date of the pending application, the modification of existing submarine hulls or construction of a towed body to carry and release a desired amount of gas to produce the upwelling was well within both design and industrial capacity and could have been implemented in a straight forward manner. (¶7).

Mr. Rondorf describes two methods by which submarines may be converted to gas carrying capacity. The first conversion method is the modification of existing submarine hulls, which he attests is a proven technology that has been executed by the United States industrial capacity. (¶8). The second conversion method involves cutting the submarine hull in half and inserting a new section specific for the desired use. (¶9). Mr. Rondorf attests that this conversion method has been successfully performed by both the United States and Russia. (¶9). As an alternative to converting existing submarine hulls to gas carrying capacity, Mr. Rondorf has described the construction of a towed body to carry and release the gas required for upwelling. (¶10).

Based upon his knowledge of submarines, Mr. Rondorf has calculated the gas carrying capacity of two existing submarines, the U.S. Trident submarine and the Russian Typhoon class submarine. (¶13). Mr. Rondorf estimated for a volume of 687 million Nm³, the volume of gas disclosed in the application, and estimating that 476 normal cubic meters of gas would be liberated per cubic meter of liquid that 1.4 million m³ liquid CO₂ would be required. (¶14). Accordingly, in the 500-600 m depths where the submersible payloads would be charged with CO₂, only 19 Typhoon hulls would be required. (¶14).

Therefore, since the Rondorf Declaration, Singleton Declaration, and Ginis Declaration concurrently filed herewith, clearly establish that it is more likely than not that the asserted utility of the claimed invention would be considered credible by a person of ordinary skill in the art, the Office cannot maintain the rejection under 35 U.S.C. § 101.

If the record as a whole would make it more likely than not that the asserted utility of the claimed invention would be considered credible by a person of ordinary skill in the art, the Office cannot maintain the rejection. *See* MPEP at 2107.02(VI).

Accordingly, Applicants respectfully request withdrawal of the 35 U.S.C. § 101 rejections to independent claims 1, 8, and 14 and their dependent claims 2-7, 9-13, and 15-17, respectively.

Claim Rejections 35 U.S.C. § 112

The Office rejects all pending claims under, 35 U.S.C. § 112, first paragraph as containing subject matter that was not described in the specification in such a way as to enable one of skill in the art to which it pertains, or with which it is most nearly connected to make and/or use the invention. Office Action at ¶ 3.

The Office presupposes that one of skill in the art would not know how to use the claimed invention. The presupposition is based on the Office's asserted lack of credible utility for the invention. As discussed in the response of September 15, 2004, the specification supports the claims and provides numerous examples of implementations of the invention as claimed. In addition the Singleton Declaration, the Ginis Declaration, and the Rondorf Declaration, show that the utility of the claimed invention is credible. The Applicants respectfully submit this rejection should be withdrawn for all of the reasons discussed in the response of September 15, 2004.

The Office expressed concern over "the grand scale or vast area of the release site." Office Action at page 5. The specification addresses this issue in its discussion of the amount of water required for upwelling. The calculation provided in the specification is given for the most intense Atlantic hurricane as of the filing date of the application, namely, Hurricane Gilbert. The exemplary calculation was based on a region to be cooled being a circle having a radius of 90 km or only about 56 miles. *See* Appln. ¶ at 0043. In another embodiment, the region of the area to be cooled is an area equal to about half the size of the central core. *See*

Appln, at ¶¶ 0061-64. It is noted that on of about September 14, 2004, the category five hurricane Ivan in the Caribbean Ocean has a core of about 30 miles. This would leave a region to be cooled on the order of only about 15 miles. Neither the worst case scenario presented as an exemplary calculation in the specification, or the present real world example of hurricane Ivan, presents a release site that is of such a grand scale or vast area as to be unreasonable for practical application of the claimed invention. The specification therefore feasibly supports the use of the invention to reduce the intensity of hurricanes.

The Office expresses concern over the amount of gas required to affect a hurricane. Office Action at page 4. The specification provides an example of the amount of gas that may be required to upwell a given quantity of water in intercepting a single storm as being approximately 687 million Nm³. *See* Appln at ¶ 0102. The application equates this to the amount of greenhouse gas produced by a 500-megawatt coal-fired power, plant over approximately a three-month operating period. *See id.* This volume of gas is not unreasonable for use in a practical application of the claimed invention. The gas could be manufactured and stored during non hurricane season. The specification therefore feasibly supports the use of the invention to reduce the intensity of hurricanes. Furthermore, Applicants have submitted the Singleton Declaration. In her Declaration, as described above, Ms. Singleton conducted numeric modeling using known bubble plume models and the information in the specification to calculate the amount of gas required for upwelling. (Singleton Declaration, ¶8). The amount of gas needed under the Singleton calculations is also readily achievable.

The Office expresses concern over, the number of submersibles required for the process. Given the equations provided for calculation of upwelling volume of water and examples of the amount of gas required to produce such an upwelling, one of ordinary skill in the art could calculate the number of submersibles needed based on the gas volume storage capability of each submersible. The art of submarine manufacture is well established in countries such as the United States, Great Britain, and the former Soviet Union. Thus, the Office's rejection based on lack of feasible support in the specification should be withdrawn.

In addition to the disclosure, Applicants have submitted the Rondorf Declaration, as described above, that provides support that the type and number of submersibles needed for implementing the claimed invention may readily be ascertained by using the amount of direction provided for in the specification and the knowledge of one skilled in the art. (Rondorf Declaration, ¶5). As discussed above, Mr. Rondorf describes two ways that submarines may be converted to a gas carrying capacity (i) modifying existing submarine hulls and (ii) cutting the submarine in half and inserting a new section specific for the desired use. (¶¶8-9). As an alternative to modifying existing submarine hulls, Mr. Rondorf states that a towed submersible body may be readily constructed to carry and release the gas required for upwelling. (¶10).

The Office further questions whether the enablement requirement is met by the specification. The standard for determining whether the specification meets the enablement requirement may be determined by asking whether the experimentation needed to practice the invention is undue or unreasonable. The specification provides considerable direction and guidance to enable one skilled in art to implement the invention in a straight forward manner using technology that existed prior to 2001 as evidenced in the Rule 132 Declarations concurrently filed herewith.

For example, the specification provides specific examples, equations, and methodologies for calculations of upwelling volume. *See* Appln. at ¶¶ 0040-64. Therefore, one skilled in the art, dealing in the practical applications of the technology, could implement apparatus to practice the claimed methods. For example, Mr. Rondorf using the information disclosed in the specification in combination with the knowledge of one skilled in the art was able to determine the number of submersibles required to carry out the claimed invention; and Ms. Singleton, using the information disclosed in the specification in combination with the knowledge of one skilled in the art was able to determine the amount of gas required to generate the upwelled water to sufficiently cool a region of the upper sea surface. The number of submersibles required to implement the invention arrived at by Mr. Rondorf leads to a number of

submersibles that can be feasibly created but may be expensive to produce. However, expense is not determinative of experimentation.

Perhaps the rejection is based on the Examiner's assertion that "due to the large nature of a hurricane, it is unrealistic for anyone human or any structure made by man to be capable of reducing the surface temperature of the of the [sic] storms central core by 2.5 degrees Celsius." Office Action at page 5. The scale of the implementation needed does not violate enablement and does not make undue experimentation. Applicants assert that specific detail is provided in the form of well reasoned interception strategies and calculations of upwelling volumes required for each strategy as supported by the Rule 132 Declarations.

For all of the above stated reasons, Applicants respectfully request withdrawal of the rejections of all pending claims under 35 U.S.C. § 112, first paragraph. Further, as stated above, Applicants also respectfully request withdrawal of the rejections of all pending claims under 35 U.S.C. § 101.

Appl. No. 09/994,860
Amdt. dated November 5, 2007
Reply to Office Action of May 4, 2007

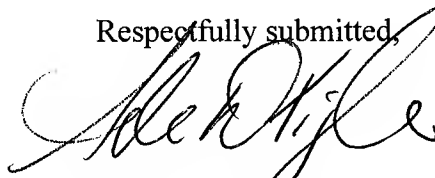
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Attorney Docket No.: 027001-000310US

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 202-481-9950.

Respectfully submitted,



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Date: November 5, 2007

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